Building Towards a Sustainable Future

EB-2022-0200 Enbridge Gas Rebasing

BOMA’s evidence with respect to Commercial Sector gas demand forecasting and related matters

Prepared by: Ian A Jarvis P.Eng, President, Enerlife Consulting Inc.

April 21, 2023

Table of contents

1. Summary

This evidence presents empirical data and the author's experience in support of the following recommendations with respect to commercial, institutional and multi-residential buildings:

1. We can and should plan for and achieve significantly greater reductions in natural gas consumption through cost-effective DSM by 2030 than forecast in the Application and Evidence, the Enbridge Gas DSM framework or the 2019 Achievable Potential Study.
2. Pathways to Net Zero modeling should consider the larger cost-effective DSM gas savings potential, and the magnitude of decarbonization achievable without adding to electrical infrastructure capacity, as presented in this evidence.
3. The next DSM framework, targets, programming and scorecards should be expanded to address:
    a. whole building portfolios, campuses and sectors to avoid unexpected and unrecognized gas consumption increases in large numbers of buildings which are offsetting most of the savings being achieved by current DSM programs and initiatives.
    b. actual post construction energy performance of new buildings and major renovations where a majority are found to be missing, often by a wide margin, the energy targets to which they were modeled and are capable of.
4. The next Achievable Potential Study for the commercial sector should be based on the publicly available BPS and EWRB data referenced in this evidence to provide more reliable and actionable forecasts.
5. Energy infrastructure planning should recognize significant changes in gas demand peaks, load shape and balance temperature, as well as annual volumes, due to current and planned energy efficiency and decarbonization initiatives by commercial building owners.
6. Planning should address the lack of accurate monthly consumption data and interval gas metering of commercial buildings, which is seriously hindering owners' energy efficiency and decarbonization efforts.
7. Rapid deployment of AMI, along with the impacts of the alternative demand forecast proposed in this evidence on capital investments, storage, customer bills and other factors in the rebasing application, should be considered for the 2024 test year and beyond.

2. Gas Demand

2.1. Annual Forecast

Figure 1 shows Canada's forecast emissions reduction from buildings to 2030 (blue line) relative to the 0.97% annual growth in commercial sector's gas consumption from Enbridge's Gas Supply Plan (red line). This evidence presents reasons for the gap between expected reductions and recent trends in gas consumption and proposes solutions to bring them in line over the course of this rebasing period.

Attachment 1 presents a composite of Enbridge's gas demand forecast data from 2019 to 2028 for the commercial sector provided in the Application and Evidence and in responses to interrogatories and undertakings. We have provided this as a table in this report and also in Excel so that assumptions and calculations are visible. The table aims to bring together general service and contract customer volumes to show totals for the commercial sector relative to residential, industrial and the system total. Note that multi-residential buildings are not included at this time although we consider them part of this evidence.

We have then added three rows, first (row 9) our understanding of the DSM reduction included in the Application and Evidence, then (row 10) the forecast reduction from the 2019 APS and third (row 11) the alternative 30% reduction scenario proposed in this evidence. We note that this third scenario still falls short of the 41% decline in emissions required by Canada's plan.

While the reporting periods for the different data sources do not entirely line up, the table shows the relative commercial sector gas consumption reductions under these three scenarios. Given the rapidly evolving circumstances of the energy transition, we recommend that sensitivity testing for proposed capital expenditures, bill impacts, storage and other outputs for the 2024 test year and beyond be conducted for this 30% alternative reduction scenario to help inform decision making.

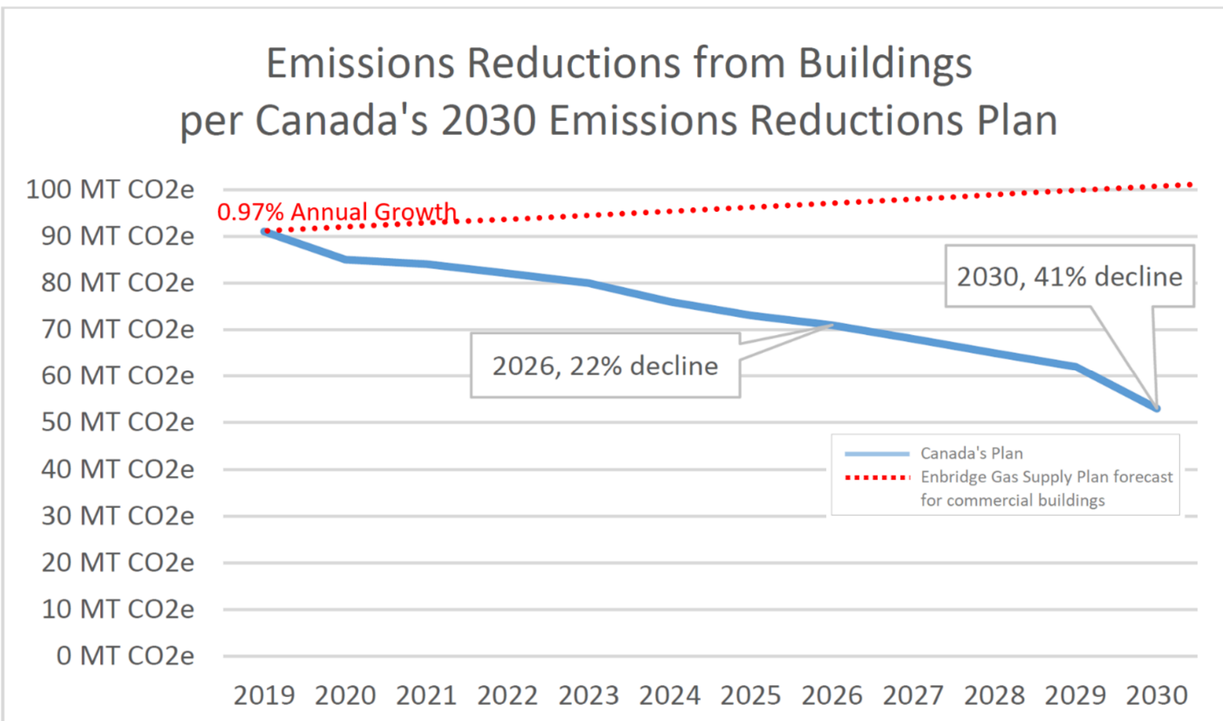


Figure 1: Emissions reduction from buildings

2.2. Peak Demand Forecast

While we are unable to separate out the shares of peak day and peak hour demand in the Application and Evidence attributable to the commercial sector, the interrogatory response to GEC-11 implies continued growth over the coming years, whereas we forecast reductions in peak gas demand for commercial buildings for reasons outlined below.

Net Zero planning by commercial building owners is beginning to focus on reductions in peak heating demand as well as annual emissions in order to reduce the size, cost and electrical loads of future low carbon heating plants. Concern over the likely ultra-high cost of "the last mile" of heating energy demand on the coldest days, when most heat pump capacity has been used up and all buildings require heat, is also driving investment in more cost-effective ways to mitigate peak heating loads.

Building envelope upgrades are part of this equation but are being applied selectively because of high capital costs. Ventilation heat recovery from exhaust air to incoming outside air, along with advanced space temperature setback controls to avoid short-term peaks, is more cost effective and has a bigger impact on heating demand. Analysis of interval gas and steam demand data during occupied and unoccupied periods demonstrates whole building peak gas demand reductions of 25% or more through ventilation heat recovery and improved space temperature control. As discussed in Section 6.1 of this evidence, introduction of interval gas metering will enable effective gas demand response to reduce unnecessary peaks which generally occur on cold weekday mornings when buildings are recovering from overnight space temperature setback.

2.2.1. Coldest Outdoor Temperatures

Figure 2 presents annual minimum temperatures recorded at Toronto Pearson Airport since 1970 (blue line) compared against what we understand to be the -28.4°C design value proposed by Enbridge. Commercial building owners are seeing and planning for higher minimum outdoor temperature trends in winter (as well as hotter peak temperatures in summer), and we recommend that gas infrastructure planning should also recognize rising outdoor temperatures.

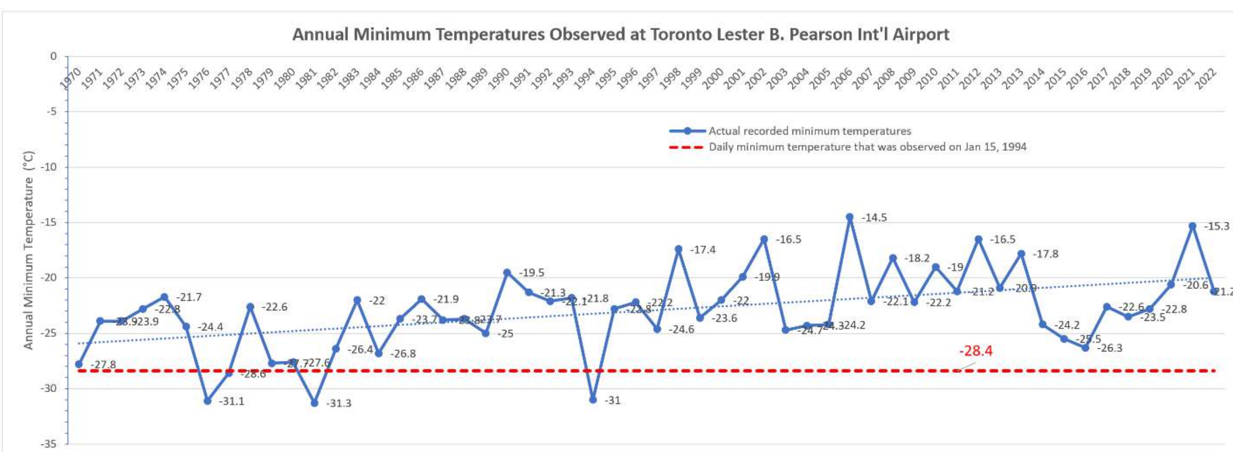


Figure 2: Outdoor temperature trends

2.2.2. Balance Temperature (BT)

As illustrated in the case studies in Sections 5.2 and 5.3 of this evidence, energy efficiency and heat recovery measures in commercial buildings have the effect of lowering the heating degree day (HDD) balance (base) temperature (BT) for buildings (the mean daily outdoor temperature below which space heating is required). Lower BTs affect weather normalization from year to year, increasing the percentage changes between colder and milder periods. While individual buildings can have lower (more energy efficient) and higher (less efficient) BTs, our analysis of large numbers of commercial buildings indicates that a 15°C balance temperature is realistic today. The modeling presented in Sections 5.2 and 5.3 shows that the BT will continue to decline as more buildings make efficiency and heat recovery improvements, increasing the demand variability from year to year.

3. DSM and Energy Transition

Figure 3 presents energy intensity data in common units of ekWh/sf for over 200 acute care hospitals from across Ontario, North America and the UK, and serves to illustrate the use of benchmarking for understanding energy use in commercial sector buildings. The data are weather normalized to Toronto. The blue bars are electricity and the orange bars are thermal energy, predominantly natural gas. All these buildings provide similar functions, yet their thermal energy use varies by more than 10:1. There is little correlation with age – a few recently built hospitals are at the top of the chart while other new facilities are below the median, and many older facilities are found in the top quartile. The predominant differences between the top performers and the rest are operational – equipment condition, scheduling and controls. While absolute energy intensities vary, this picture is repeated across all commercial building types.

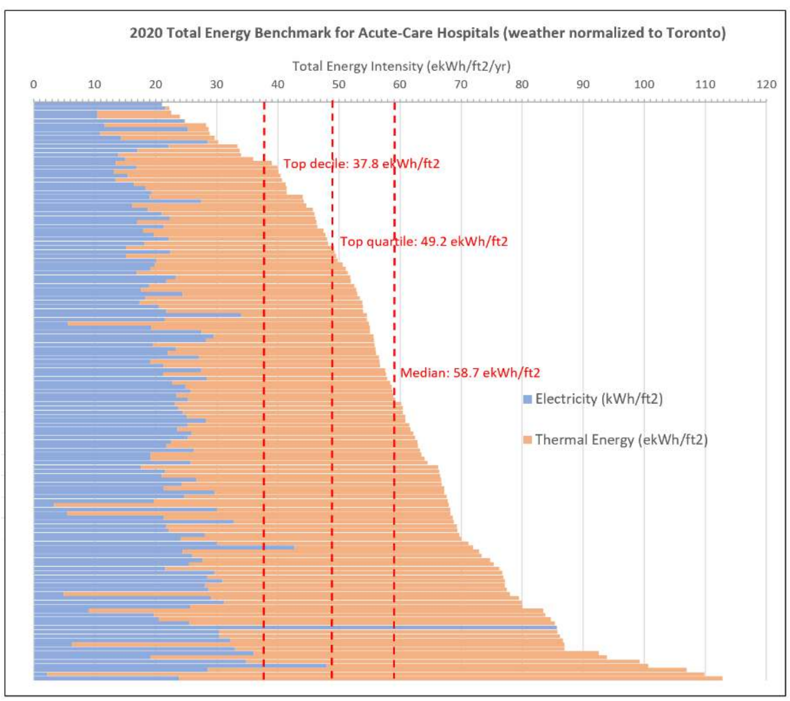


Figure 3: 2019 Total energy benchmark for hospitals

Performance-based conservation, which is used for DSM and CDM programming in commercial buildings, uses these data to estimate achievable electricity and thermal energy savings potential for individual buildings, portfolios and sectors. Empirical targets are set, typically at the top-quartile level of the benchmark charts. Target adjustments are applied to account for material differences between individual buildings, including weather and heating/cooling system types. Achievable savings are then determined for each building as the difference between its actual and target energy use. The methodology is applied by commercial landlords and large-scale programs in Ontario's hospital, municipal, K-12 schools and post-secondary sectors for planning and directing their energy efficiency initiatives.

Table 1 presents top quartile target gas savings potential for a range of commercial building types derived from a number of data sources. This top quartile standard is considered readily attainable through improved operations, maintenance and controls along with targeted cost-effective retrofits, and typically offers positive ROIs and TRCs. A number of leading owners are committing to higher levels of savings than these top quartile targets.

Sector	Estimated gas consumption (m3)	Estimated gas consumption (TJ)	Target savings (m3)	Target savings (TJ)	Target savings (%)	Notes
Multi-Family (Rental Units)	647,147,531	24,100	217,042,605	8,083	34%	2021 EWRB benchmark data
Retail	495,232,044	18,442	141,218,512	5,259	29%	2021 EWRB benchmark data
Schools	291,270,021	10,847	95,573,526	3,559	33%	Sustainable Schools Top Boards Report 2022 (school year 2019-2020)
Offices	346,350,402	12,898	94,623,363	3,524	27%	2021 EWRB benchmark data
Hospitals	307,584,628	11,454	60,759,363	2,263	20%	Greening Health Care Conservation Potential, 2019 BPS data
Colleges	32,669,110	1,217	10,505,234	391	32%	Post Secondary Climate Challenge Target Finder, 2019 BPS data
Municipal admin buildings	11,480,058	428	2,919,363	109	25%	Mayors' Megawatt Challenge, 2019 BPS data
Fire Halls	7,844,513	292	2,768,206	103	35%	Mayors' Megawatt Challenge, 2019 BPS data
TOTAL	**2,139,578,307**	**79,677**	**625,410,174**	**23,290**	**29%**	

Table 1: Estimated gas use and savings potential by building type, top quartile targets.

Based on Table 1, we propose a 30% reduction in weather normalized gas use for the commercial buildings' sector (general service and contract customers) relative to a 2019 baseline as an appropriate alternative forecast for 2030, against which to test bill impacts, gas infrastructure investments and storage requirements for the rebasing models. Equivalent target gas savings from the 2019 APS Study are close to

10% (2030 semi-constrained[1]) and Enbridge's current DSM Plan forecasts about 0.4%. All these numbers fall short of Canada's 41% emissions reduction target shown in Figure 1.

4. Actual Savings Trends in Commercial Buildings

4.1. Three Steps Forward, Two Steps Back

Figure 4 presents the actual weather normalized electricity and gas savings in 2020 vs 2019 for Ontario hospitals using the BPS reported data for the two years. The top section of each chart contains the hospitals making savings which, in some cases, are greater than 30%. The bottom sections are the hospitals recording energy increases, some of which are in excess of 30%. Table 2 summarizes these results as follows:

- 130 hospitals recorded electricity savings worth 2.4% of total baseline consumption, which were offset by increases in 27 other hospitals resulting in a net **increase** of 0.1%.
- 112 hospitals recorded gas savings worth 2.4% of total baseline consumption, offset by increases in 45 other hospitals resulting in just 0.1% net **savings** for the year.

	Savings	Number of buildings	% of Total 2019 Consumption	Increases	Number of buildings	% of Total 2019 Consumption	Net Savings / Increases	% of Total 2019 Consumption	Net Savings tonnes eCO2
Electricity	32,251,859 kWh	130	2.4%	-33,065,160 kWh	27	-2.4%	-813,301 kWh	-0.1%	-24.4
Natural Gas	5,709,909 m3	112	2.4%	-5,420,664 m3	45	-2.3%	289,245 m3	0.1%	554.2

Table 2: 2020 vs 2019 Energy Savings - Hospitals

[1] Traditional APS modeling underestimates energy savings due to operations, maintenance and controls

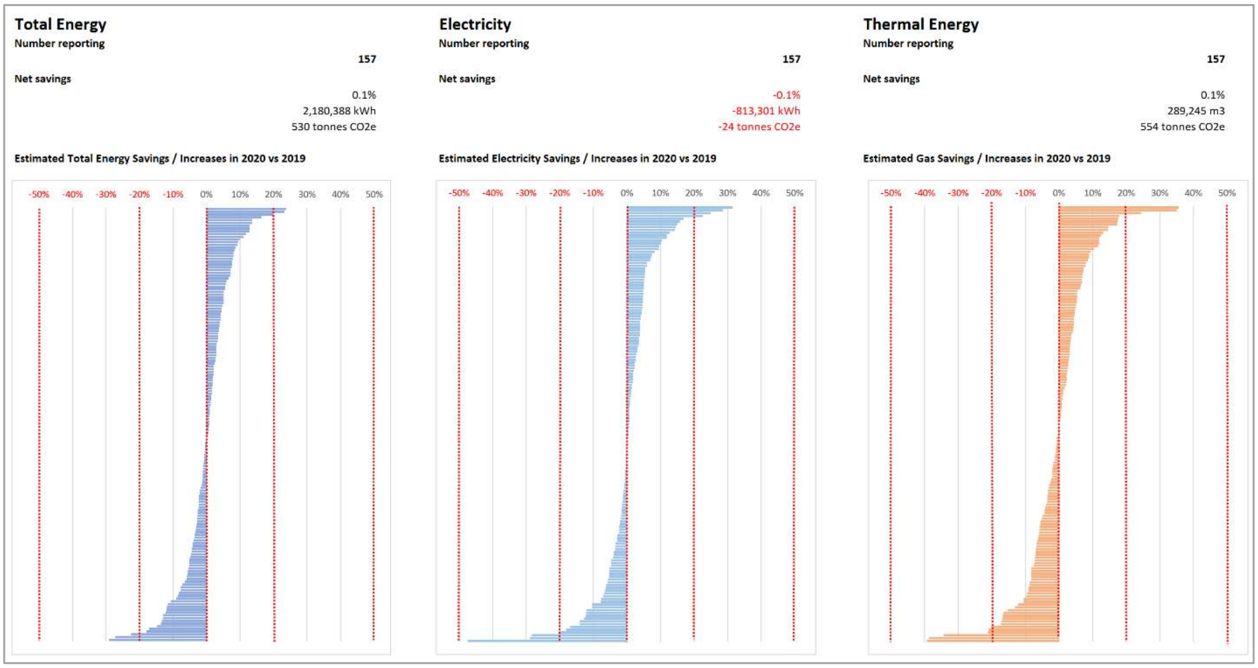


Figure 4: Actual weather-normalized energy savings and increases for Ontario hospitals in 2020 vs 2019

These results are typical of what we're seeing across other commercial building sectors and portfolios, with "three steps forward and two steps back" resulting in little or no net year on year savings. They help explain the gap between the gas savings we should be seeing from energy efficiency efforts and what is actually happening. Owners are often conscious of the causes of energy savings, but generally unaware that energy increases are occurring or of the operational missteps and equipment failures causing them. The effects of mandated changes in building operations due to COVID are being seen in most building types over the past 2 years, but these trends were apparent prior to the pandemic. As discussed in Section 6.2 of this evidence, new strategic energy management (SEM) DSM programming is required to address organizational alignment and management practices for early identification and response to unexpected changes in energy use[2].

4.2. New Building Performance – Getting it Right the First Time

A second leading contributor to the gap between actual and expected gas consumption is found in new buildings, where many fail to meet the energy efficiency targets to which they were modeled. Figure 5 is the Energy Savings Potential (top-quartile targets) benchmark chart from Greening Health Care's 2022 Working Towards World-Class Energy Efficiency in Hospitals report (available on Greening Health Care website). The darker shaded hospitals with the codes were all constructed to LEED standards under Ontario's public-private partnership model and opened since 2005. The rest of the benchmarked data set

[2] Sustainable Schools conducted an SEM applied research project in 2022 with the IESO and 5 Ontario school boards. View the guidance report here: SEM for School Board Portfolios Guidance Report.

are older hospitals. Only a handful of the 19 new facilities have achieved the exceptional energy performance of which all should be capable.

Similar results are being found with other commercial building types, both in new construction and major renovations, where large capital investments and current practices are not delivering high-performance outcomes. As discussed in Section 6.2, the Savings by Design program should be expanded to engage more buildings and renovations and modified to incorporate empirical best practice standards and post construction performance verification in order to consistently "get it right the first time."

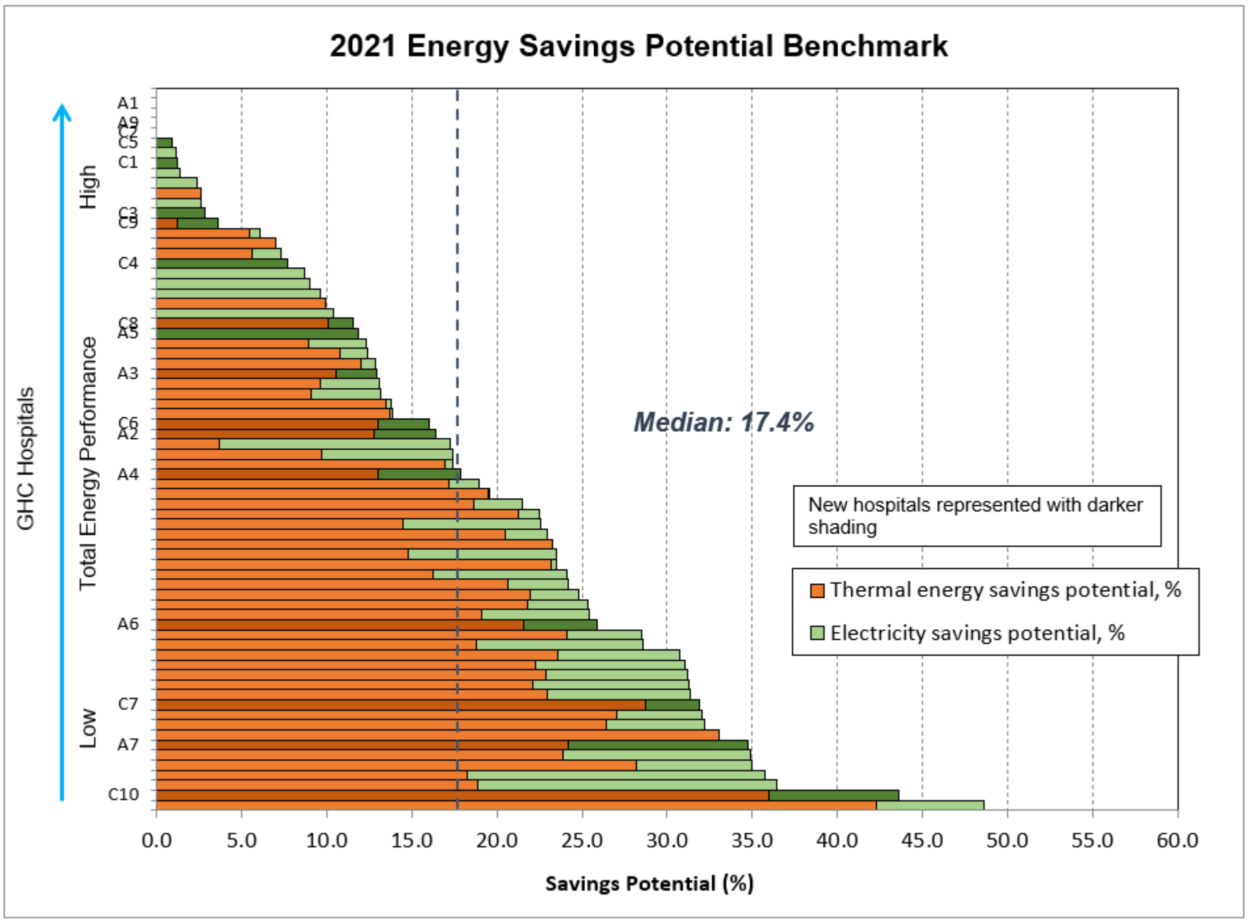


Figure 5: Energy performance of the new AFP hospitals relative to other (older) Greening Health Care member hospitals

5. Practical Pathways to Net Zero

5.1. Evolving Market

A growing number of public- and private-sector commercial building owners are planning, setting targets and taking action towards net zero greenhouse gas emissions. The strategies, methods and market dynamics of the low carbon energy transition in the commercial sector are very different from the residential or industrial sectors. While there are significant differences between commercial building types, most differ from residential buildings (single family homes) in two major ways:

- Large ventilation systems, which account for as much as half of building heating loads and have the potential for highly efficient heat reclaim from exhaust air to preheat outside air makeup, which can significantly and cost effectively reduce peak as well as annual gas demand.
- Large internal heat gains which are currently rejected to atmosphere but are increasingly being recycled to offset heating requirements in winter. For example, there is a large-scale national program underway for retrofitting arena facilities to displace fossil fuels used for space and water heating with heat recovered from the ice plant condensers.

The Government of Canada is also engaging more with commercial buildings, with two current large funding initiatives:

- Code Acceleration Fund which can be expected to focus attention on the energy performance of new buildings.
- Deep Retrofit Accelerator Initiative which is building capacity for scaling up and aggregating integrated energy efficiency and decarbonization projects.

Enbridge's net zero planning and forecasting should be aligned as fully as possible with rapidly evolving dynamics in the commercial buildings' sector. The case studies presented in Sections 6.2 and 6.3 are provided to help inform strategy, programming and anticipated changes to both the volume and shape of gas demand as commercial building owners work towards decarbonization.

5.2. Commercial Office Net Zero Roadmap

Figure 6 presents the office building EUI benchmark chart, in common units of ekWh/sf for electricity and thermal energy, derived from the Ontario 2019 (pre-COVID) EWRB reporting. Total energy ranges from below 15 to over 50 with a median of 25.3. The industry target of 20, promulgated in 2009 by the Real Property Association of Canada (REALPAC), the Canada Green Building Council (CAGBC) and BOMA, is shown for reference in Figure 6, and it should be noted that the median at that time was 35. Each building is broken down into electricity (blue) and thermal energy (predominantly natural gas in orange), indicating the energy efficient thermal standard of 5 which we use for planning purpose today.

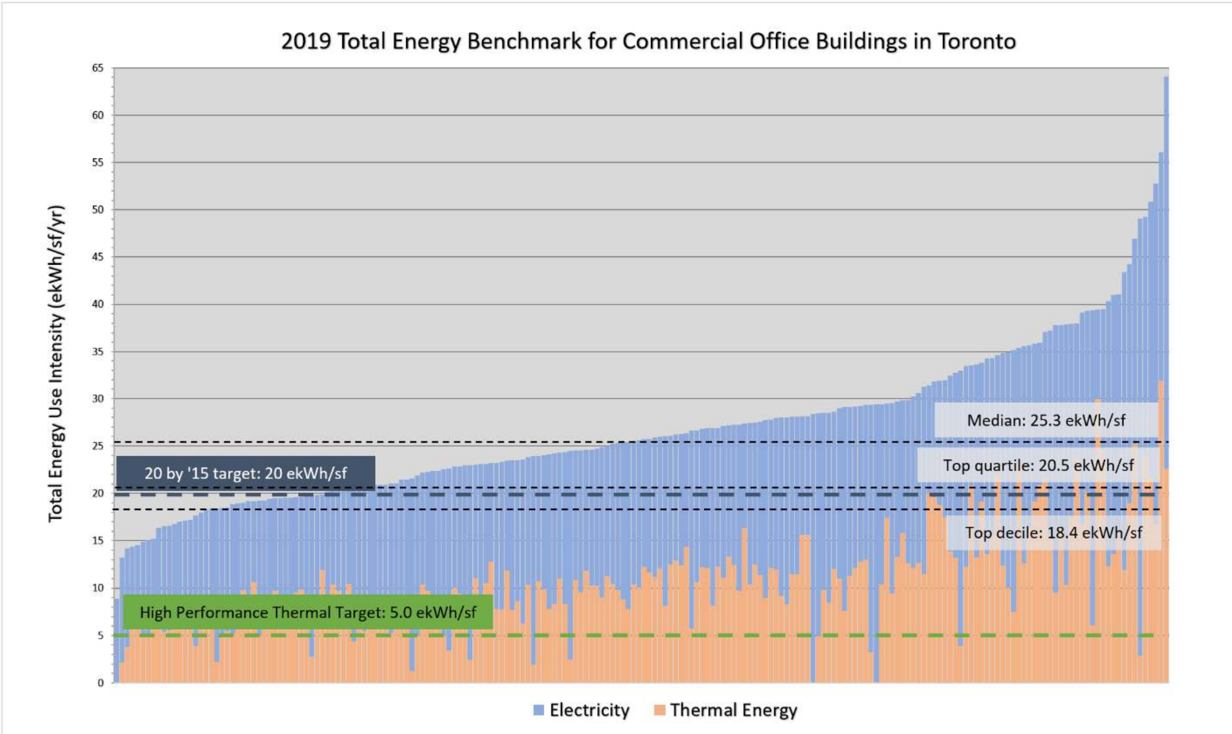


Figure 6: EWRB commercial office benchmark 2019: EUI electricity and thermal energy

Our recommended strategy for commercial buildings working towards net zero is consistent with Enbridge's safe bets approach, beginning with maximizing cost-effective energy efficiency measures. The second big step for most commercial buildings is heat recovery – 1) in ventilation systems, reclaiming heat from exhaust air in winter to preheat incoming outside air and 2) reclaiming internally generated heat from sources such as computer equipment, ice making (in arenas) and refrigerated storage (grocery stores and warehouses) which is now rejected to atmosphere in winter through cooling towers and air-cooled condensers and can be upgraded to heat the building.

Figure 7 presents the progression of natural gas demand for a representative office building from its 2010 baseline (already relatively efficient when their energy efficiency program began) through its 2018-19 performance to the energy efficient target and then application of ventilation and internal heat recovery. The relatively small residual heating requirement (2.3 ekWh/sf) will be addressed in future with renewable energy and carbon offsets. This level of heat recovery will be achieved within the building's existing electrical capacity to avoid significant investment in upgraded electrical infrastructure by the owner or the electricity distributor.

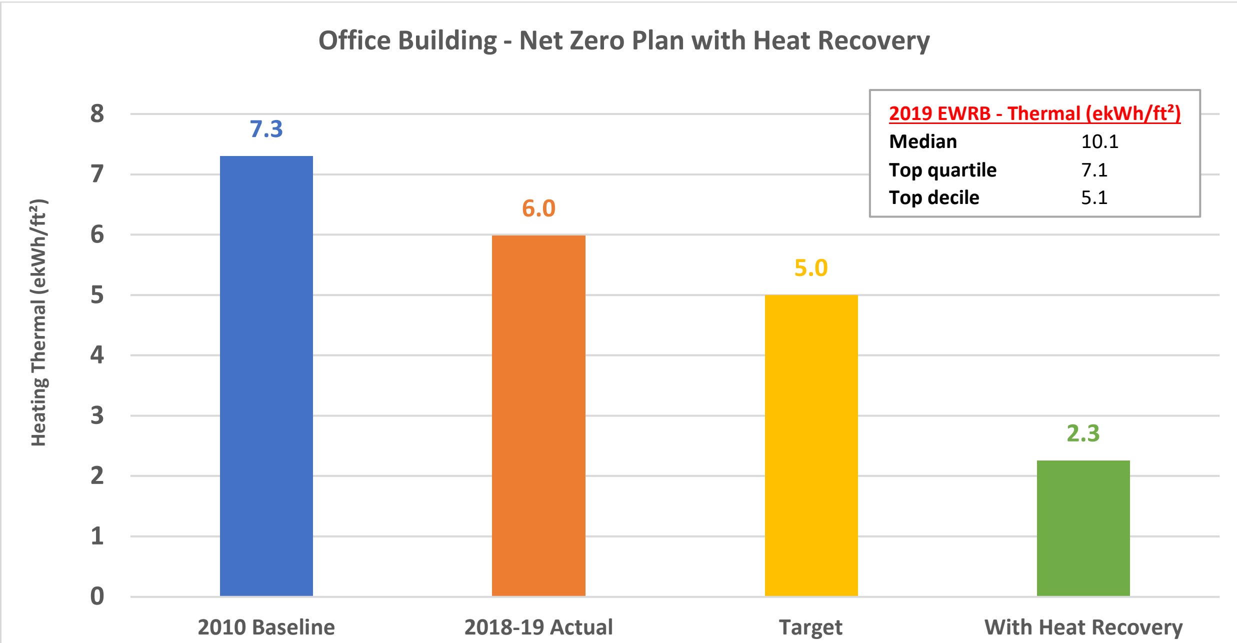
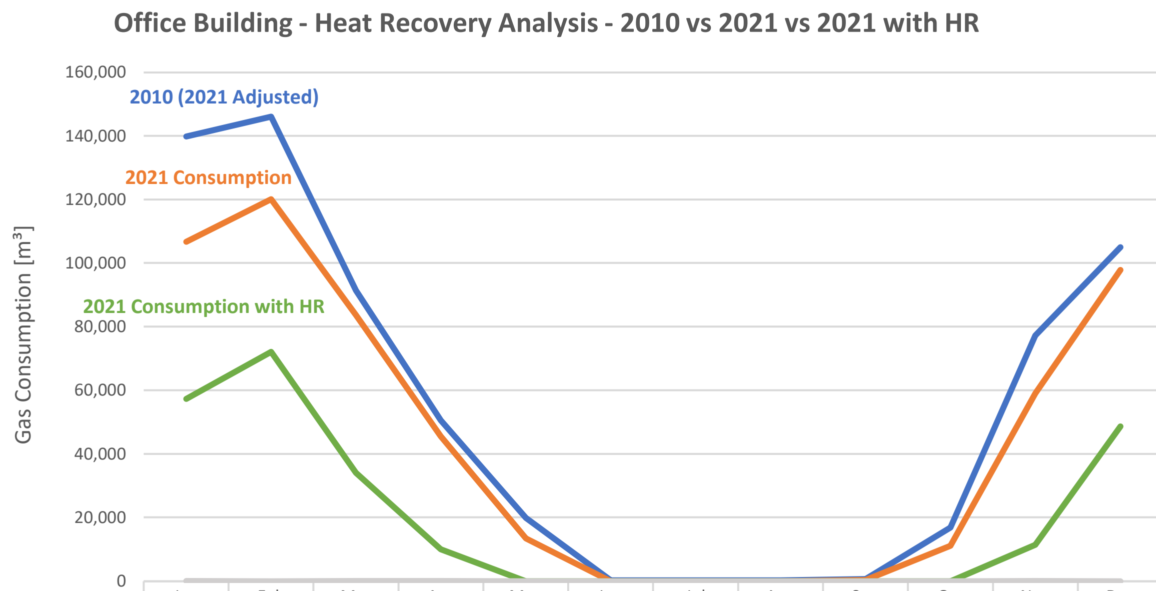


Figure 7: Progression of natural gas demand commercial office building



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010 (2021 Adj)	139,785	146,068	91,387	50,508	19,850	250	258	258	598	16,798	77,193	104,961
2021 Total	106,636	120,140	83,671	45,491	13,363	0	0	0	292	11,131	58,976	97,779
2021 with HR	57,279	72,110	34,035	9,969	0	0	0	0	0	0	11,424	48,672
Reduction	59%	51%	63%	80%	100%	100%	100%	100%	100%	100%	85%	54%

Figure 8: Monthly consumption office building

Figure 8 shows the corresponding changes in monthly gas consumption for each stage of this progression. Exhaust air heat recovery is more pronounced in colder weather and has the effect of lowering peak heating demand as well as gas consumption. Internally generated heat on the other hand is generally consistent throughout the year and displaces a larger proportion of gas use in milder months than in cold weather. Overall monthly reductions in gas consumption relative to the weather normalized 2010 baseline range from 51% in the coldest month to 100% for 6 months of the year.

5.3. K-12 School Net Zero Roadmap

Figure 9 presents the 2018-19 (pre-COVID) benchmark chart for Ontario's K-12 schools from the 2021 Sustainable Schools report with a median of 18.1 ekWh/sf of total energy. Figure 10 breaks out thermal energy use showing the wide range from below 5 to over 25 ekWh/sf. While a number of the lower thermal energy users have heat pump systems, the predominant cause of the differences is found to be operational factors.

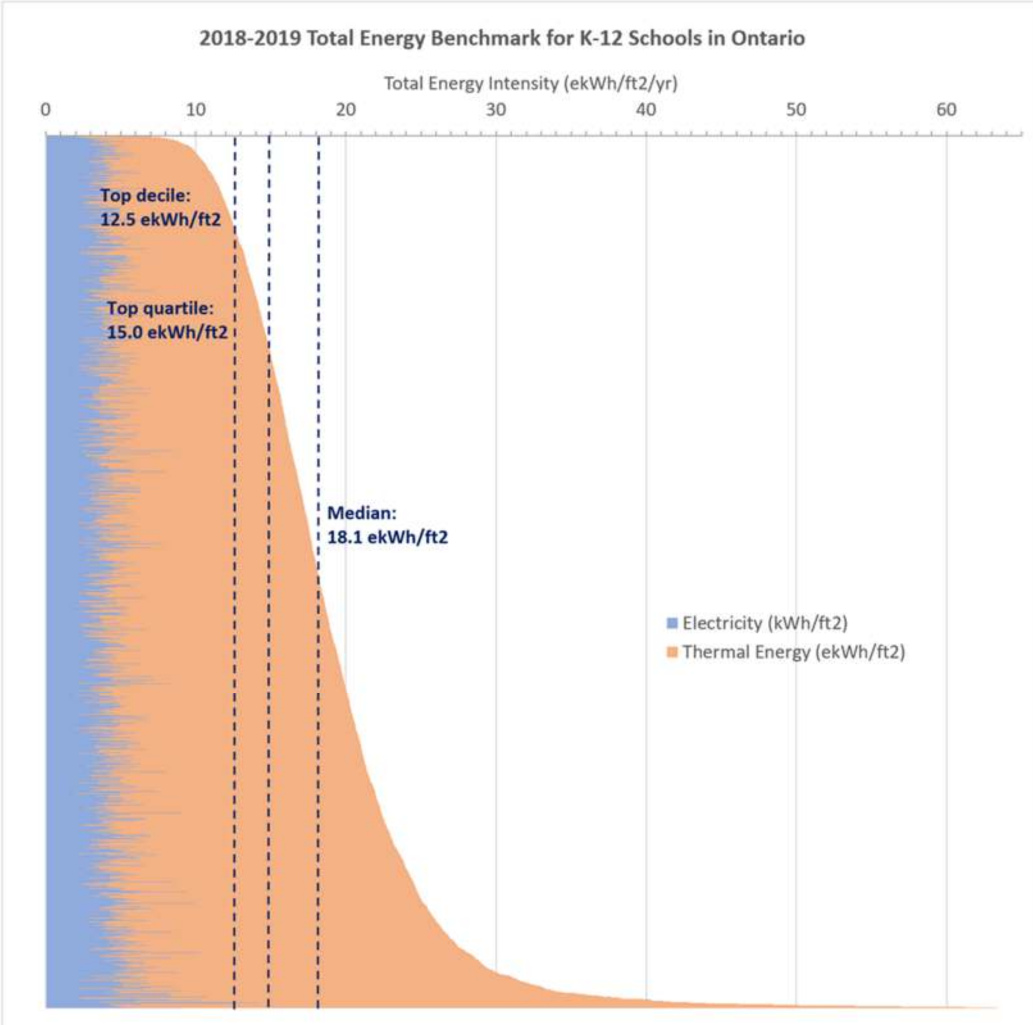


Figure 9: 2021 Sustainable Schools Report 2018 – 2019 EUI benchmark chart: electricity and thermal energy

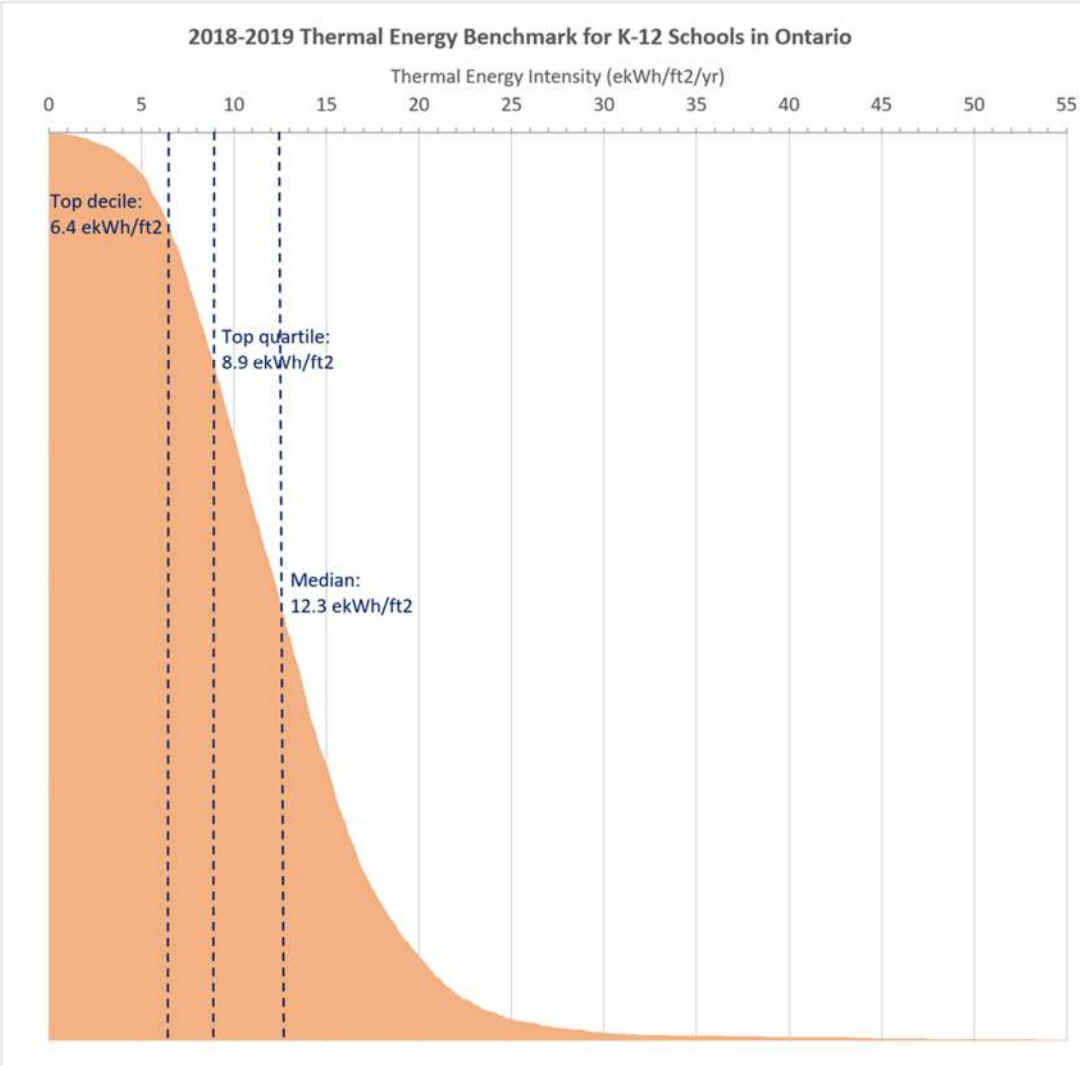


Figure 10: 2021 Sustainable Schools Report 2018 – 2019 EUI benchmark chart: thermal energy

The practical pathway towards net zero emissions for K-12 schools again begins with maximizing energy efficiency. Schools have relatively low internal heat gains and air source heat pumps (ASHPs which draw heat from outside air), combined with exhaust ventilation heat recovery, are the second big step for this building type towards decarbonization[3]. Ground source heat pump (GSHP) applications for schools are more expensive but have the benefit of maintaining efficiency in cold weather[4].

---

[3] A research project into high performance rooftop HVAC units including ASHPs was conducted by Sustainable Schools with the IESO and industry in 2022)

[4] About 1% of Ontario's schools are now equipped with GSHPs and Sustainable Schools research is beginning into applications for new schools and existing retrofits.

Figure 11 presents the progression of natural gas demand for a representative secondary school from its 2018-19 baseline through more efficient 2020-21 operation to its energy efficiency target (4.7 ekWh/sf) and application of the ASHP coupled with exhaust air heat recovery. The small residual heating requirement of less than 1 ekWh/sf will be addressed in future with renewable energy and carbon offsets. The ASHP is again sized to be within the building's existing electrical capacity.

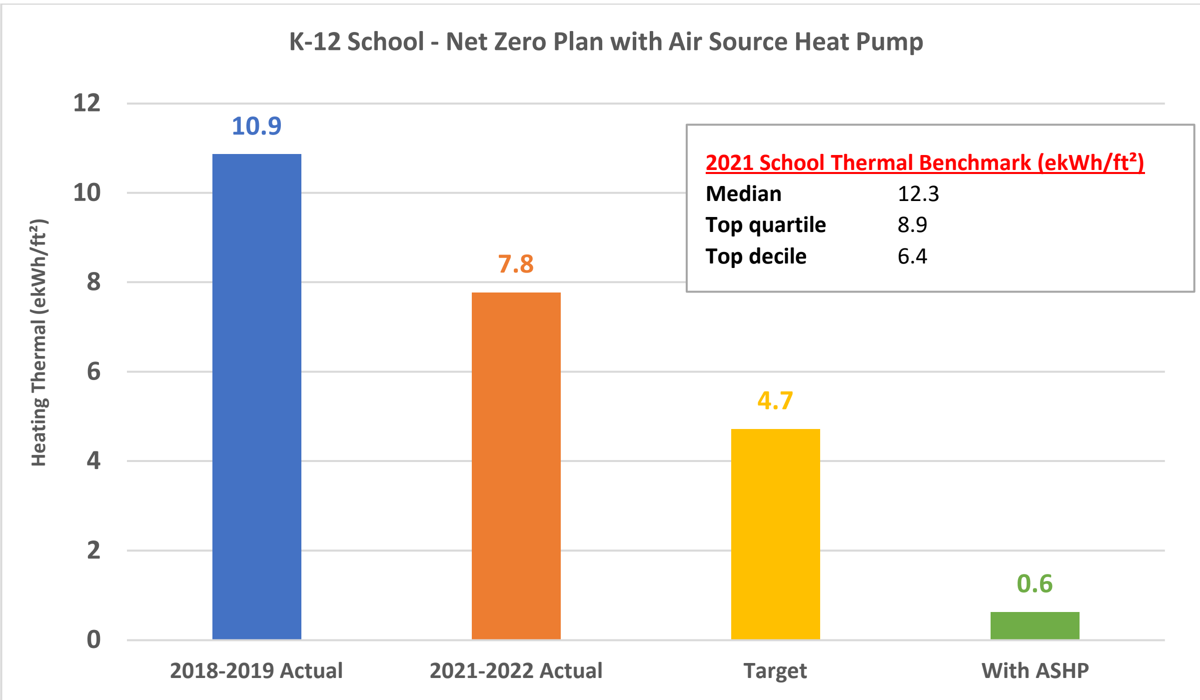
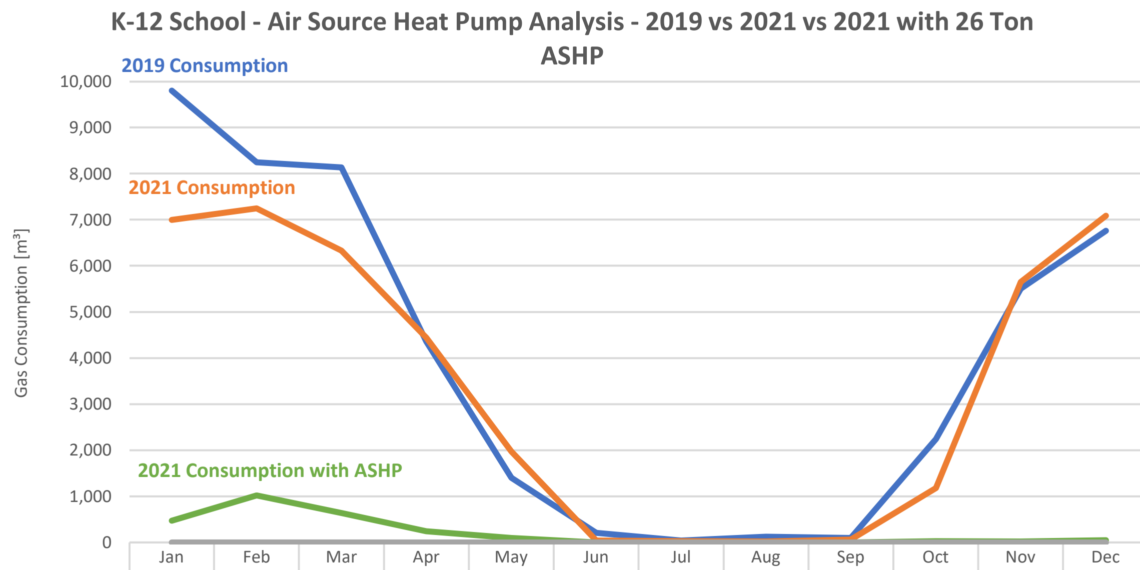


Figure 11: K12 School buildings net zero roadmap



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019 Actual	9,801	8,246	8,136	4,356	1,398	209	47	127	96	2,243	5,501	6,759
2021 Actual	6,997	7,249	6,327	4,443	1,972	42	29	25	64	1,179	5,651	7,088
2021 with ASHP	473	1,020	639	242	99	2	0	0	0	27	22	46
Reduction %	93%	86%	90%	95%	95%	95%	100%	100%	100%	98%	100%	99%

Figure 12: Progression of natural gas demand for secondary school

Figure 12 shows the changing monthly gas consumption volumes for each stage of this progression. Exhaust air heat recovery has the effect of lowering peak heating demand as well as gas consumption. The ASHP becomes less efficient at lower outdoor temperatures and therefore displaces less gas under peak demand conditions. Overall monthly gas use reductions range from 86% in the coldest month to almost 100% for 8 months of the year.

5.4. Heating Balance Temperatures

Energy efficiency and heat recovery also result in lower balance temperatures – the mean daily outdoor temperature below which heating is needed to maintain the required indoor space temperature. Table 3 shows the heating balance temperatures for each of these case study buildings at each stage of the progression towards net zero.

	Baseline	Energy Efficient	With Heat Recovery/ASHP
Commercial Office	15°C	14.1°C	7.9°C
Secondary School	17.9°C	15.5°C	1.7°C

Table 3: Balance temperatures

6. Other Considerations

6.1. Advanced Metering

Ready access to reliable energy use data is a foundation of commercial sector building owners' energy management efforts. BOMA is an active participant in the Industry Working Group which is supporting implementation of Ontario's Green Button regulation. Commercial owners invest in Energy Management Information Systems (EMIS) to monitor consumption over time. They actively participate in Ontario's BPS and EWRB reporting regulations to benchmark energy use of individual buildings and portfolios against peers. They use monthly and hourly interval data to uncover savings opportunities and estimate savings potential to make the business case for investment in energy efficiency improvements. While "smart" electric metering (along with water metering in some jurisdictions) has been providing reliable monthly and interval data for over a decade to support these essential data analytics, continued prevalence of estimated gas bills and absence of hourly data for general service accounts present a serious roadblock to commercial owners' DSM and decarbonization initiatives.

Interval gas metering can also support Integrated Resource Planning (IRP) by identifying the timing and magnitude of gas demand peaks. Electricity Demand Response (DR) is common practice in commercial buildings. Data indicate that gas demand peaks are generally driven by heating systems recovering from overnight space temperature setback on cold mornings. Gas DR can play a useful role in reducing, deferring or avoiding capital investment in gas supply infrastructure.

We recommend that implementation of the Advanced Metering Infrastructure for commercial buildings be prioritized and expedited as an essential component of DSM and IRP programming necessary to meet Ontario's and Canada's energy and climate goals.

6.2. Future DSM Programming

Our analysis of available data highlights four primary strategies for changing the trajectory of natural gas demand and greenhouse gas emissions by delivering the full natural gas savings potential in individual commercial buildings, portfolios and campuses:

1. New Buildings – Getting it right the first time:

Many new buildings fail to meet the energy performance standards to which they were modeled and are capable of[5]. Application of increasingly rigorous Energy Codes, standards[6] and metrics (including NRCan's Codes Acceleration Fund) with empirical data, coaching and performance verification will make every new building the best it can be. We recommend expansion and addition of empirical best practice standards and post-construction performance verification linked to incentive payments for Enbridge's Savings by Design program.

[5] View 2022 Update on Energy Performance of Ontario's New Hospitals: Working Towards World-Class Energy Efficiency in Hospitals, available on Greening Health Care website
[6] View GHG report: Using Performance Metrics to Deliver Highly Energy Efficient Healthcare Facilities

2. Existing Buildings – Performance-Based Conservation:

Data show that a relatively small of existing buildings holds the lion's share of the energy savings potential, with the biggest differences between high- and low-energy performers found in building systems' operations, maintenance and controls. We recommend focus on high savings potential buildings for all commercial ownership types, building on the experience with the whole building Pay for Performance pilot project underway for K-12 schools.

Custom DSM programming should also fully support deep energy and decarbonization retrofits, leveraging NRCan's Deep Retrofit Accelerator Initiative over the next 4 years to help implement integrated, large-scale plant and building system conversions to low carbon designs and emphasizing ventilation heat recovery and heat recovery chiller installations as described in this evidence.

3. Portfolio/Sector/Provincial Energy Management

Section 5.1 of this evidence describes the prevalence of energy, in particular natural gas, increases which are largely offsetting gains made through DSM. New Strategic Energy Management (SEM) programming is recommended, with a different kind of scorecard, to address the management reporting and response systems needed for early identification and remedial action to correct the operational missteps and equipment malfunctions which cause these largely unexpected and unreported changes. Advanced gas metering recommended in Section 7.1 is considered essential to enable effective SEM programs.

4. Commercial Sector Definition and Reporting

In addition to advanced metering, improved targeting and reporting of achievable potential studies and DSM program design for both general service and contract commercial customers is recommended to enable higher levels of savings. We understand that some 20% of contract customers (about 225 out of over 1,000) are commercial buildings, accounting for approximately 5% of total volume for those rate classes. They make up less than 0.1% of all commercial customers but consume close to 7.5% of total commercial sector gas use. They mostly have large gas savings potential and justify special attention for DSM and IRP opportunities.

Among general service customers, commercial users are entirely different from residential, and the energy systems, owner needs and capabilities, and DSM/decarbonization strategies and opportunities vary considerably between private- and public-sector owners and between the different segments of the market. For example, there are important differences between commercial offices, municipal community centres, apartment buildings and hospitals which need to be effectively represented in DSM design.

Multi-residential buildings span private and public ownership. From a DSM perspective they are more closely aligned with the commercial than the residential sector. We have not been able to identify their numbers and gas demand, which will be additive to the recommendations in this evidence, and we recommend that they be separated from residential for APS and DSM purposes.

Glossary

AMI	Advanced metering infrastructure
APS	Achievable potential savings
ASHP	Air source heat pump
BPS	Broader public sector
BT	Balance temperature
CDM	Conservation and Demand Management
EMIS	Energy management information systems
EUI	Energy use intensity
EWRB	Energy and water reporting and benchmarking
DSM	Demand side management
GSHP	Ground source heat pump
HDD	Heating degree day
IRP	Integrated resource planning
LEED	Leadership in energy and environmental design
ROI	Return on investment
SEM	Strategic energy management
TRC	Total resource cost

Attachment 1

Actual and Forecast Normalized Volumes Based on 2024 Test Year Weather Normalization (By Sector)

Line No.	Particulars (10^3m3)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2030
		Actual	Actual	Actual	Actual	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast	
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	
	General Service (1)											
1	Residential	8,034,144	8,166,924	8,044,339	8,040,778	8,149,365	8,179,258	8,209,652	8,234,539	8,260,731	8,284,447	
2	Commercial	6,436,062	6,289,129	6,069,543	6,224,539	6,441,180	6,448,091	6,429,395	6,408,538	6,389,423	6,370,410	
3	Industrial	1,135,057	1,028,084	990,918	945,873	1,084,500	1,060,859	1,045,617	1,030,553	1,016,838	1,002,565	
4	**Total General Service**	**15,605,263**	**15,484,137**	**15,104,801**	**15,211,190**	**15,675,046**	**15,688,207**	**15,684,664**	**15,673,630**	**15,666,992**	**15,657,422**	
5	**Contract (Commercial)**					**649,390**	**645,823**	**641,065**	**636,349**	**631,634**	**626,953**	
6	**Total Contract**	**10,409,038**	**10,407,657**	**11,364,220**	**12,226,415**	**12,026,774**	**12,234,665**	**12,456,037**	**13,289,325**	**13,296,345**	**13,285,182**	
7	**Total Volumes**	**26,014,301**	**25,891,794**	**26,469,020**	**27,437,604**	**27,701,820**	**27,922,873**	**28,140,701**	**28,962,955**	**28,963,338**	**28,942,604**	
8	**Total Commercial**					**7,090,570**	**7,093,914**	**7,070,460**	**7,044,887**	**7,021,057**	**6,997,363**	
9	Commercial DSM	34,390	20,030	24,942	28,327	26,464	27,006	27,643	TBD	TBD	TBD	
10	2019 APS Forecast					186,000	248,571	311,143	373,714	436,286	498,857	624,000
11	30% reduction by 2030						303,882	607,763	911,645	1,215,526	1,519,408	2,127,171